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(54) Title: VACUUM CLEANERS

(57) Abstract

Vacuum cleaning apparatus having air flow generating means to generate an airflow from a nozzle means to a receptacle to entrain dirt and debris and to transport said dirt and debris to the receptacle for collection and ultimate disposal, in which the air flow generating means is a fan driven by electric motor which latter is rated to produce a fan rotation speed greater than 24,000 rpm and a fully open air flow of greater than 3 m^3. In a particular aspect of the invention the effect is to use a smaller motor and make it work much harder and faster in order to achieve a given air flow performance and then providing corresponding insulation around the motor to reduce the noise therefrom to below 50 dba.

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VACUUM CLEANERS

DESCRIPTION

This invention relates to vacuum cleaning apparatus and has particular reference to vacuum cleaning apparatus of the cannister or cylinder type. Such vacuum cleaning apparatus comprises in general a receptacle for the collection of dirt and debris, inlet means for the admission of dirt and debris to said receptacle, collection means in operative connection with said inlet means for collection of said dirt and debris, air flow generating means to generate an air flow, from said collectiong means to said receptacle, to entrain dirt and debris and to transport said dirt and debris to said receptacle for collection therein and ultimate disposal. Such apparatus is generally well known and will be referred to hereafter as "apparatus of the kind described".

Such apparatus of the kind described operates by generating an air flow over a surface or object to be cleaned, the air flow being such that particles of dirt, dust and debris are dislodged from the surface

upon which they reside and are entrained in the air flow and are carried by the air stream to the collection receptacle. As the air flow enters the collection receptacle the increased space within which the air flow can move results in a slowing down of the air with the result that the dirt, dust and debris are deposited within the receptacle. In typical vacuum cleaning apparatus currently available, the air flow generating means is a fan driven by an electric motor. The fan may be a displacement fan and/or a centrifugal fan and in order to obtain satisfactory performance a motor rating of something of the order of 1000 W is necessary with an air flow of the order of 2.5 cu.metres per minute. The amount of air flow depends, of course, on the diameter of the connection between the collection means and the inlet means to the dirt or debris collection receptacle; in general the larger the diameter of the connecting means, the greater needs to be the volume of the air flow to provide the necessary velocity to maintain the dirt, dust and debris in entrainment within the air flow for transport to the receptacle for subsequent deposit therein.

Current motors operate at a rating of 1000 W with a spindle velocity of 19000 to 23000 rpm. Such motors are typically insulated by a layer of thick wool lagging around the outer casing of the motor and such a machine will typically generate a noise output of the order of 58 dba.

Numerous attempts have been made to reduce the noise of vacuum cleaning apparatus. Some reduction can be effected by including more sound insulation material around the motor. This can reduce the sound output by up to 3 dba but, in some designs of cleaner, this presents an increasing problem in terms of cooling of the motor.

Many attempts have been made to decrease the noise output of vacuum cleaners while maintaining their cleaning effectiveness by increasing the size of the motor and having it work at a slower speed and/or in a less stressed manner. This has the disadvantage that an increase in fan size is necessary in order to obtain the same volumetric air displacement. The advantage of this arrangement is that the motor exerts

more power and in the fully blanked off condition, a pressure decrease of 2500 mm of water gauge or more can be obtained. The disadvantage of this arrangement is, of course, the increase in size and bulk of the components concerned. This in turn allows for less free space within in any given motor housing to accommodate sound insulation material.

The present applicants have, contrary to established practice in the industry, sought to deal with the problem by providing in one aspect of their invention vacuum cleaning apparatus of the kind described in which the air flow generating means is a fan driven by an electric motor which motor is rated to produce a fan rotation speed greater than 24000 rpm and a fully open air flow of greater than 3 cu.metres per minute.

The applicants have found, surprisingly, that by using a smaller electric motor and running it at a higher speed, they are able to incorporate an increased amount of sound insulation in juxtaposition the motor and reduce the noise therefrom to below 50 dba.

In a particular aspect of the present invention the air flow may be 3.3 cu.metres per minute and the noise level may be reduced to below 47 dba.

The applicants have found that in spite of the use of a smaller motor and higher operating speeds they are still able to obtain, in the fully blanked off condition, a suction within the range of 2000 to 2400 mm water gauge.

The fan may be a displacement fan or is preferably a centrifugal fan. In a particular aspect of the invention, the fan is a centrifugal fan having a plurality of blades, each of which has a longer leading edge at the air intake than trailing edge at the exhaust. In a further aspect of the invention, the length of the leading edge of each blade exceeds the length of the trailing edge by a ratio of at least 1.7:1.

In a typical embodiment of the invention, the motor is mounted on soft gasket means within a motor housing. This serves to insulate the motor from direct contact with the housing of the vacuum cleaning apparatus so

as to reduce the transmission of vibration from the motor to the surroundings. The housing surrounding the motor and fan may accommodate a plurality of layers of noise reduction material. The said layers may be selected to filter out noise of different frequencies.

The motor may be a high speed motor which is small in size and light in weight and has, therefore, the overall effect of reducing the lower frequency vibrations generated by the motor in use.

Following is a description by way of example only and with reference to the accompanying drawing of methods of carrying the invention in to effect.

In the drawing:

The Figure is a section through the motor housing of a cannister vacuum cleaner.

The housing indicated generally at (10) comprises a cylindrical body portion (11) having a substantially circular upper wall (12) and enclosed at its lower end

by a contoured motor supporting wall (13). The wall (13) is provided towards its centre with a substantially frustoconical dependant portion (14) having a further depending air inlet portion (15) is provided with a central opening to allow the ready ingress of air. The dependent portion (14) is provided with an annular, contoured rubber gasket (16) which serves as support for a motor and fan assembly indicated generally at (20). The motor assembly (20) comprises a motor body (21) having electrical connections (not shown) and a drive spindle connected to a fan (not shown) which latter is accommodated in a lower fan housing (22). Lower housing (22) is provided with a central bottom opening (23) for the admission of air which is drawn into the fan housing (22) and is expelled therefrom via the motor housing (21) as shown by the dark arrows in the accompanying drawing.

The motor and fan assembly (20) is secured in position by a clamping plate (27) which acts on a second annular contoured gasket (28) to secure the motor and fan assembly (21) in position. The motor and fan assembly

(21) is therefore secured to the housing (10) only through the means of the gaskets (16, 28).

The internal surface of the housing is provided with a first layer of sound insulation material (40) and internally of the housing there is also provided a substantially cylindrical internal wall comprising a series of layers (41, 42, 43 and 44) of insulation material. The space between the cylindrical wall (11) and the internal wall formed by layers (41, 42, 43 and 44) defines an annular plenum chamber (30).

The upper portion of the inner cylindrical wall of insulation material is closed by means of circular layers of insulation material (42, 43 and 44). Insulation material layers (43, 44) is of a foam rubber material and the remaining layers (40, 41, and 42) are selected each from a different material to damp out specific frequencies of sound generated by the motor.

The cylindrical insulation layers (41, 42, 43 and 44) define a cage-like structure having a plurality of slots to permit air to pass from the area of the motor

housing (21) to the plenum chamber (30). The outer cylindrical housing (11) is also provided with a plurality of openings (48) to allow air to be exhausted to the atmosphere.

The apparatus described above has been found to provide a substantially reduced noise level. The motor has been found to be operable at speeds between 24000 and 30000 rpm with a motor rating of 1000W. The motor is smaller and lighter and the air flow can be increased to well above 3.0 cu.metres per minute. The fully blanked suction is still within the range 2000 to 2500 mm water gauge but is reduced when compared with prior art machines with the result when the nozzle is blocked with the machine still running, it is easier to remove the blockage.

It is well known that by using a smaller motor and making it run faster, the stress on the motor is substantially increased. By making it run faster, however, and reducing the motor and fan size and weight, the frequency of the generated noise is also significantly increased. The surprising feature of the invention is the fact that it is easier to absorb

the higher frequencies generated and since the motor is smaller there is more room for sound insulation in any given motor housing. Furthermore since the motor itself is lighter there is less transmitted vibration and the lighter motor is more readily cushioned on rubber gaskets as illustrated above than would a more powerful, heavier motor.

CLAIMS

1. Vacuum cleaning apparatus comprising a receptacle for the collection of dirt and debris, inlet means for the admission of dirt and debris to said receptcale, nozzle means in operative connection with said inlet means for the collection of dirt and debris from a surface or area to be cleaned and airflow generating means to generate an airflow from said nozzle means to said receptacle to entrain dirt and debris and to transport said dirt and debris to said receptacle for collection therein and ultimate disposal characterised in that the said airflow generating means is a fan driven by electic motor which motor is rated to produce a fan rotation speed greater than 24000 rpm and a fully open airflow of greater than 3 cu.m. pm.

2. Apparatus as claimed in claim 1 characterised by an electric motor having sound insulation in juxtaposition thereto to reduce the noise therefrom to below 50 dba.

3. Apparatus as claimed in either of the preceeding claims in which the open airflow is 3.3 cu.m. pm or greater.

4. Apparatus as claimed in any preceeding claim characterised in that the audible noise level is below is 47 dba.

5. Apparatus as claimed in any preceeding claim characterised in that the motor has a fully blanked suction within the range of 2000 to 2500 mm water guage.

6. Apparatus as claimed in any preceeding claim characterised in that the fan is a displacement fan or a centrifugal fan.

7. Apparatus as claimed in claim 6 characterised in that the fan is a centrifugal fan having a plurality of blades, each blade of which has a longer leading edge at the intake than trailing edge at the exhaust.

8. Apparatus as claimed in any preceeding claim characterised in that the length of the leading edge of each blade exceeds the length of the trailing edge by a ratio of 1.7:1.

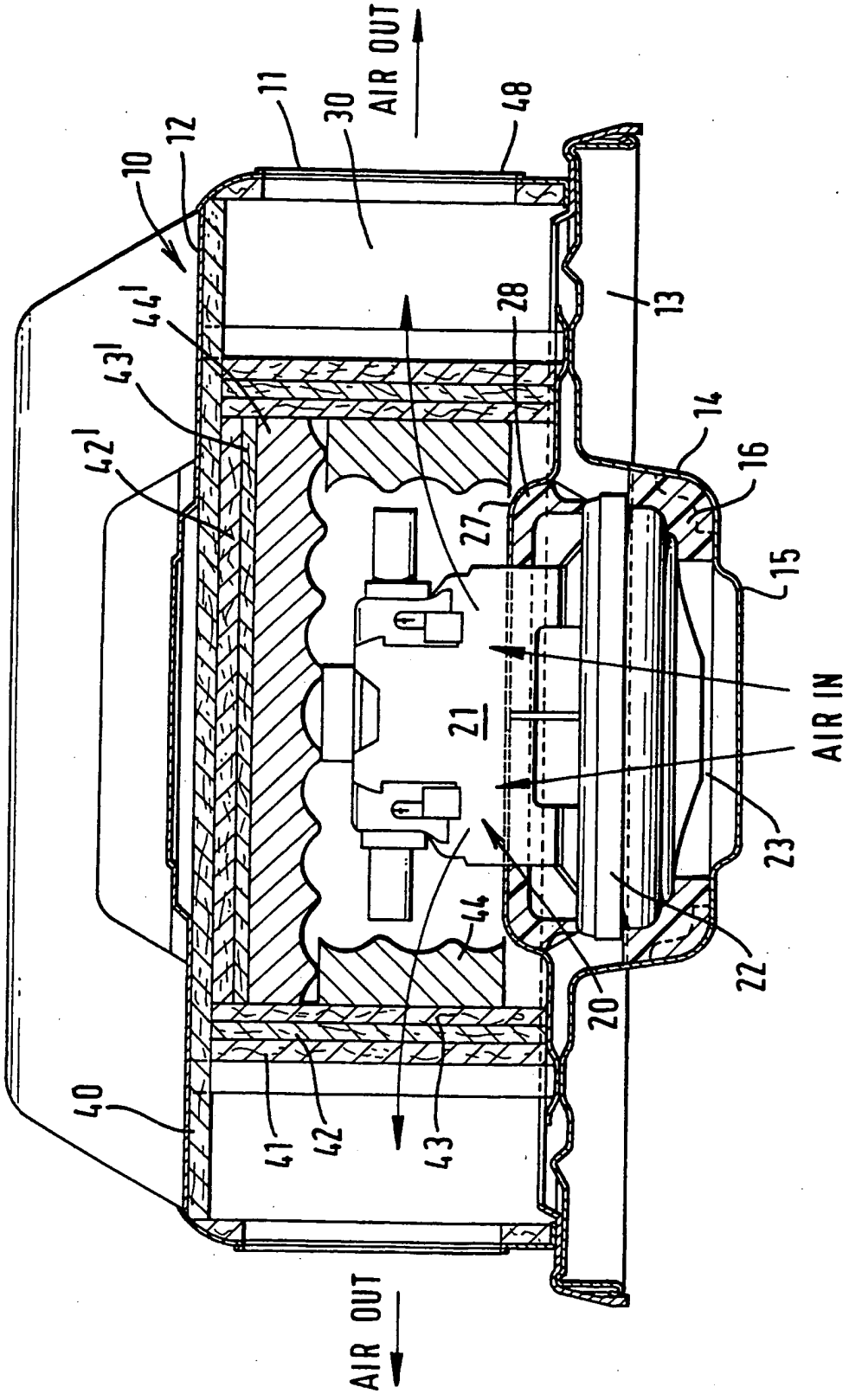
9. Apparatus as claimed in any preceeding claim characterised in that the electric motor is mounted on a soft gasket means within a motor housing.

10. Apparatus as claimed in any preceeding claim characterised in that the housing surrounding the motor and fan accomodates a plurality of layers of noise reduction material, said layers being selected to filter out noise at different frequencies.

11. Apparatus as claimed in any preceeding claim characterised in that the insulation layers are arranged to find a cage like structure having a plurality of slots to permit air to pass from the area of the motor housing to a plenum chamber.

12. Apparatus as claimed in any preceeding claim characterised in that the motor has an operating speed of betwen 24000 and 30000 rpm with a motor rating of 1000 watt.

FIG. 1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INTERNATIONAL SEARCH REPORT

Inter nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A47L9/00 A47L9/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 528 451 (DAEWOO ELECTRONICS CO LTD) 24 February 1993 see page 4, line 44 - page 11, line 4; figures ---	1,2,4,6, 10-12
Y	PATENT ABSTRACTS OF JAPAN vol. 9, no. 194 (M-403) 10 August 1985 & JP,A,60 060 300 (MATSUSHITA DENKI SANGYO KK) 6 April 1985 see abstract ---	1,2,4,6, 10-12
P,Y	WO,A,94 15519 (AB ELECTROLUX) 21 July 1994 see abstract --- -/--	1,6,10, 11

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,Y	PATENT ABSTRACTS OF JAPAN vol. 18, no. 256 (P-1738) 16 May 1994 & JP,A,06 035 478 (TOKYO ELECTRIC CO LTD) 10 February 1994 see abstract	1,6,10, 11
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 253 (M-1263) 9 June 1992 & JP,A,04 060 199 (MATSUSHITA ELECTRIC IND CO LTD) 26 February 1992 see abstract	6-8
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INTERNATIONAL SEARCH REPORT

.nformation on patent family members

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WO-A-9415519	21-07-94	SE-B-	470563	29-08-94
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		FI-A-	940080	09-07-94
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